

A DESCRIPTIVE LIST OF THE CEPHALINE GREGARINES OF THE NEW WORLD

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Introduction.

Aside from Central Europe little is known of the Cephaline gregarine fauna of the world. Like many other groups of animals which have no large economic importance at present, cephaline gregarines have been neglected. Particularly is this true of the New World fauna. Gregarines are however deserving of more attention if only as objects of scientific interest, since they are easily obtainable and offer excellent material for both class work and experimental research. It is the object of the present paper to bring together the references to the new world species and some information regarding the group *Cephalina* Delage. Short descriptions and measurements have been added to aid in the determination of specimens.

History.

Although gregarines had been seen and reported by several writers before 1828, the first formal description of a genus and species of cephaline gregarines was made in that year by Leon Dufour (1828). He established the genus *Gregarina* and defined *G. ovata* from *Forficula auricularia* L., an earwig. He had however discussed gregarines in an earlier paper (1826). Dufour considered gregarines as peculiar worms and this idea dominated the work of several subsequent authors. Gregarines were variously regarded as parasitic worms, both Nematode and Trematode, and were even assigned to the plant kingdom by some. Koelliker (1848), was one of the first zoologists to maintain that gregarines are one-celled animals. The taxonomic knowledge of cephaline gregarines has been advanced particularly through the works of A. Schneider (1875 et. seq.), and of L. Leger (1892 et. seq.).

The first paper dealing with new world gregarines was published by Joseph Leidy in 1849. This included a short diagnosis of the genus *Gregarina* and the description of a new species, *G.*

larvata from *Julus marginatus*. In his discussion Leidy states that "in the state in which *Gregarina* is found, it would probably hold rank between the *Trematoda* and *Trichina*, the lowest of the *Nematoidea*". Subsequently Leidy published several other notes and descriptions of gregarines. No further attention was given the new world forms until Frenzel (1892), gave the descriptions and the results of some experimental work upon five new species of gregarines from Argentine Republic. Crawley (1903a,b; 1907), in a series of three articles offered the first connected account of the cephaline gregarines of the United States, describing new species from Leidy's unpublished manuscript and several from his own investigations.

At the present time 56 species, some of which are incompletely described, are known from North and South America. This undoubtedly is but an introduction to our fauna.

Anatomy and Life Cycle.

Cephaline gregarines are protozoan parasites, usually found in the alimentary canal of arthropods. They are most commonly taken in the free adult stage, the sporont, from the posterior portion of the alimentary canal of the host. A sporont (fig. 13), typically consists of two parts separated by a septum, so that it superficially appears to be made up of two cells. The anterior of these units is the protomerite, and the posterior, containing the nucleus, the deutomerite. The septum between the protomerite and the deutomerite is usually well developed but in some genera, as *Gamocystis* A. Schneider, the septum is wanting, the protomerite being represented by but a constriction. The other extreme is found in the peculiar gregarine *Tacniocystis mira* Leger from *Ceratopogon solstitialis* Winn., in which the deutomerite is divided by several granular septa. The outside coat of a sporont, the epicyte, is quite thin and rather firm as contrasted with the semi-fluid material, the endocyte, which fills it. Often just below the epicyte a thin clear zone, the sarcocyte, may be seen. The endocyte is usually quite dense and homogeneous although it may be almost clear, and may contain large and small granules and oil drops. The nucleus is suspended in this endocyte unattached as may be demonstrated by crushing a sporont, with pressure from a cover glass,

without crushing the nucleus, when the nucleus will be forced out of the epicyte. Often the nucleus is not visible but it may always be made so by staining with a weak solution of Iodine in Potassium Iodid (the usual Grams solution diluted one-half with water answers very well for this).

Since the life cycle of all cephaline gregarines is much the same, although those of the various species differ in detail, *Gregarina blattarum* Siebold from cockroach will be used as an example. The fusion of two sporonts in the alimentary canal of the first host produces a cyst. This is a prolate spheroid covered with a gelatinous envelope. After being discharged from the alimentary canal of the first host the cyst, if it be kept moist, passes through a series of internal changes, which result in the formation of sporocysts, commonly called spores. These are discharged from the cyst through long tubes, the sporoducts. The period during which the cyst produces sporocysts, up to the time when they are discharged, is known as the maturation period. The maturation changes, although begun before the cyst has left the body of the first host, rarely if ever are completed in the first host.* Each sporocyst, after it has been subjected to the proper conditions of moisture, discharges several sporozoites. Infection of the second host may take place either as the result of the ingestion of sporozoites, or of the sporocysts from which the sporozoites may be discharged. In either event the intracellular phase of the life cycle is begun by the sporozoite. This enters a cell of the alimentary canal of the new host and after a time develops into a minute gregarine, composed of three parts, a deutomerite, a protomerite and an epimerite, the latter being in front of the protomerite and joined to it. Later the young gregarine withdraws from the cell of the host so that only a portion of the epimerite remains within the cell, the remainder of the body being in the alimentary canal of the host. When the gregarine has attained a certain growth it leaves the cell entirely and becomes a free parasite in the canal, although still bearing the epimerite. This stage is the

*Crawley, (1903b, p. 641) has suggested, from the advanced stage of maturation in which he found the cysts of *G. achetaeabbreviatae* in the host, that sporocysts may occasionally be discharged in the host. Leger et Duboscq (1902, p. 412), report the sporocysts of *Pyxnia mobuszi* as occurring in the excrement of the host.

cephalont. The loss of the epimerite constitutes the change to the sporont stage and the cycle is completed.* The various stages differ somewhat with the several families and will be discussed in the diagnoses of the families.

Technique.

Gregarines are best studied while living. The alimentary canal may be withdrawn from a recently decapitated arthropod and teased in normal salt solution. Many species of gregarines will live for hours in either normal salt solution or Ringer's solution. When placed in water the osmotic tension usually causes them to swell up and burst. This difficulty may be overcome by the addition of a little white of egg. Permanent mounts are usually made with considerable difficulty if attempt be made to handle the individual animals. Balsam mounts may be made however by killing and staining portions of the alimentary canal of the host and teasing them when in balsam. Sections of the alimentary canal are also good, showing the intracellular stages as well as the free forms. The cysts are to be collected from the faeces of the host. By isolating several individuals of the host species in clean test tubes plugged with cotton, the faeces may be collected free from debris. The faeces should be examined with a low power glass after soaking in water. The cysts when removed from the faeces should be placed in a damp-cell on a slide. Care must be used to protect the cysts from mold.

Taxonomy.*

Since the sporonts of many species are quite similar the taxonomic characters are drawn for the most part from the epimerite, the cyst and the sporocyst. Often all of the stages were not at hand, so that many species are incompletely described, in the original diagnoses. In the descriptions given here the letters "P" and "D" refer to protomerite and deutomerite respectively, and the measurements are for average sporonts or spores.

*For a detailed account of the intracellular stages and their development see Leger and Duboscq, 1904.

*In making up the brief descriptions of the species given, data from specimens seen by the writer were used as far as possible; these wanting, the descriptions were composed from the figures given with the original diagnoses, which in the case of gregarines must correspond in general to the types of larger animals. The figures given here are from drawings by the writer unless otherwise credited.

CEPHALINA DELAGE

Sporozoans reproducing by sporulation only, which usually follows the permanent fusion of two adult individuals; gametes similar or dissimilar; young stages always intracellular; epimerite present in the first extracellular stage or at least represented in the last intracellular stages; adult generally divided by a septum into a deutomerite and a protomerite. This group includes the Polycystid Gregarines of authors.

KEY TO THE FAMILIES OF CEPHALINA

- A. With a free cephalont stage.
 - B. Sporonts forming associations;* epimerite simple.
 - C. Septum of the satellite disappearing; dehiscence by simple rupture*Didymophidæ*
 - CC. Septum of the satellite present.
 - D. Dehiscence of cyst by simple rupture..... *Hyalosporidæ*
 - DD. Dehiscence of cyst by sporoducts.....*Gregarinidæ*
 - BB. Sporonts not forming associations; epimerite usually not simple.
 - E. Septum present in the sporont.
 - F. Dehiscence of cyst by simple rupture.
 - G. Sporocysts without spines.....*Actinocephalidæ*
 - GG. Sporocyst with spines.....*Acanthosporidæ*
 - FF. Dehiscence of cyst by a pseudocyst, either central or lateral.
 - H. Epimerite symmetrical and symmetrically attached to the protomerite*Stylocephalidæ*
 - HH. Epimerite asymmetrical or asymmetrically attached to the protomerite*Dactylophoridæ*
 - EE. Septum wanting in the sporont.....*Doliocystidæ*
 - AA. Epimerite represented only in the last intracellular stages.*Stenophoridæ*

*Two or more sporonts joined in tandem, see fig. 5; the first of these sporonts is termed the primite and the posterior individuals the satellites.

DIDYMOPHIDÆ

A family of one genus, the species of which are known only from Europe.

Didymophes F. Stein, 1848, s. 186.

Type—*D. gigantea* F. Stein, 1848, s. 186, t. 9, f. 40; from *Oryctes nasicornis* (L.) larvae,—*Coleoptera*.

HYALOSPORIDÆ

This family is in part the *Gregarinidæ* of authors. As here defined it includes only those Gregarinids whose cysts delisce by simple rupture. Seven genera, one provisionally, are referred to

this family. One new world species is known, although doubtless several occur.

- a. Septum present, protomerite and deutomerite distinct.
 - b. Sporocysts ellipsoidal to spindle-shaped; ends somewhat pointed.
 - c. Sporocyst with distinct equatorial swelling.....*Frenzelina*
 - cc. Sporocyst without equatorial swelling.....*Hyalospora*
 - bb. Sporocysts not ellipsoidal; ends broadly rounded.
 - d. Sporocysts not spherical.
 - e. Sporocyst ovoid or cylindrical.....*Eirmocystis*
 - ec. Sporocyst prismatic, polygonal in outline.....*Euspora*
 - dd. Sporocyst spherical or subspherical.....*Uradiophora*
 - aa. Septum wanting.
 - f. Sporont globose.....*Sphaerocystis*
 - ff. Sporont elongate*Ganymedes*

Frenzelina Leger et Duboscq, 1907, p. 773-774.

Type—*F. conformis* (Diesing)=*Gregarina conformis* Diesing, 1851, II, p. 15; from *Pachygrapsus marmoratus* (F.).—*Crustacea*.

Hyalospora A. Schneider, 1875, 4, p. 583.

Type—*H. roscoviana* A. Schneider, 1875, 4, p. 584, t.16, f.41-42; from *Petrobius maritimus*.—*Thysanura*.

Euspora A. Schneider, 1875, 4, p. 582.

Type—*E. fallax* A. Schneider, 1875, 4, p. 583, t.18, f.14-17; from *Rhizotrogus æstivus*.—*Coleoptera*.

Euspora lucani Crawley. Fig. 1.

Euspora lucani Crawley, 1903a, p. 50-51, pl. III, f.38; Swarthmore, Pennsylvania, from *Lucanus dama* Thunb.—*Coleoptera*.

Epimerite undescribed; elongate and cylindrical, protomerite and deutomerite both broadly rounded; size as given by Crawley, l.c., primate $520\mu \times 128\mu$, satellite $360\mu \times 108\mu$; cysts unknown. This species is referred to the genus *Euspora* because of the shape of the sporont and the coleopteran host, making the generic determination very uncertain.

Eirmocystis Leger, 1892, p.110.

Type—*E. ventricosa* Leger, 1892, p. 111, t.6, f.1-4; from *Tipula oleracca* and *Tipula pratensis* larvæ.—*Diptera*.

Uradiophora Mercier, 1912, p. 198.

Type—*U. cuenoti* (Mercier)=*Cephaloidophora cuenoti* Mercier, 1911, p. 51; from *Atyæphya desmaresti* Millet.—*Crustacea*.

Ganymedes J. Huxley, 1910, p. 169.

Type—*G. anaspidis* J. Huxley, 1910, p. 155-175, pl. 11, f. 1-19; from *Anaspides tasmaniae* (Thompson).—*Crustacea*.

This genus is placed here provisionally because of the similarity of *Ganymedes anaspidis* and *Uradiophora cuenoti* in several features of morphology and in type of host. Since the complete life cycle of *Ganymedes* has not been worked out this arrangement cannot be verified at present.

Sphærocystis Leger, 1892, p. 115.

Type—*S. simplex* Leger, 1892, p. 115, t. 6, f. 11-13; from *Cyphon pallidus* larvæ,—*Coleoptera*.

GREGARINIDÆ

Cysts spherical or ovoid, covered by a gelatinous envelope which is often double; one or more sporoducts forming during maturation, through which the sporocysts are discharged; sporocysts often in chains. As here defined this family includes but part of the species of *Gregarinidæ* of authors, the other genera being referred to *Hyalosporidæ*. Two of the three genera are represented in the new world fauna.

- a. Septum present; protomerite and deutomerite distinct.
 - b. Sporoducts several.....*Gregarina*
 - bb. Sporoduct one, large.....*Gigaductus*
- aa. Septum wanting*Gamocystis*

Gregarina Dufour, 1828, p. 366.

Type—*G. ovata* Dufour, 1828, p. 366; from *Forficula auricularia* L.,—*Orthoptera* (*Euplexoptera*).

Of the twenty species from the new world assigned to the this genus the generic determination of but six is absolute, since the dehiscence of the cysts has not been described for the other fourteen. It has been the custom of authors to refer any gregarine found in association to this genus when the data were insufficient for complete determination; hence a large number of species have been placed here tentatively.

Gregarina blattarum Siebold. Figs. 20-22.

Gregarina blattarum Siebold, 1839, s.57,t.3: Crawley, 1903a, p. 44; from *Periplaneta orientalis* and *Ectobia germanica*: Hall, 1907, p. 1; Lincoln, Nebraska, from *Periplaneta americana*: Ellis, 1913c, p. 83; Douglas Lake, Michigan from *Ischnoptera pennsylvanica*.

Gregarina blattæ-orientalis Leidy, 1853, 230, pl. 11, f.11-12; from *Blatta orientalis*.

Clepsidrina blattarum, Magalhães, 1900, p. 38-44; Brazil, from *Periplaneta americana* and *Periplaneta orientalis*.

Epimerite short, digitiform to subglobose, about one-half the length of the protomerite of the cephalont; sporont short and broad, both protomerite and deutomerite broadly rounded; average P. 100µx120µ, D. 130µx400µ; cysts prolate spheroids, average 450µx900µ with gelatinous envelope; sporoducts to or more, reaching the length of 200µ; sporocysts barrel-shape. 4µx8µ.

Gregarina panchloræ Frenzel. Fig. 9.

Gregarina panchloræ Frenzel, 1892, s.299, f. 20; Cordoba, Argentine Republic, from *Panchlora exoleta* Klug.

Epimerite undescribed; sporont cylindrical, length 180μ , width $30-35\mu$; cysts and sporozoites unknown. In associations the protomerite of the satellite is deeply concave at the anterior end to receive the posterior end of the deutomerite of the primate. From the measurements given by Frenzel, a completion of his figure 20 would make the deutomerite about six times as long as the protomerite. This gregarine may be a synonym of the following species. Specimens of *Panchlora* sp. from Quirigua, Guatemala, and from bananas shipped into Boulder, Colorado, were examined by the writer in 1912 but no gregarines found.

Gregarina blaberæ Frenzel. Fig. 2.

Gregarina blaberæ Frenzel, 1892, s. 300-314, f. 21-33; Cordoba, Argentine Republic, from *Blabera claraziana* and related forms.

Epimerite long, tapering, shaped like a spear-head, enlarged at the base, about twice the length of the protomerite of a large cephalont; sporont elongate, protomerite and deutomerite both broadly rounded; adult sporont $150\mu \times 500\mu$, protomerite about one-fourth the length of the deutomerite; cysts and sporozoites unknown. A specimen of *Blabera* sp. from Gualan, Guatemala contained no gregarines.

Gregarina serpentula Magalhães. Fig. 3.

Gregarina serpentula Magalhães, 1900, p. 40, f. 4; Brazil, from *Periplaneta americana*.

Epimerite unknown; sporont elongate, $180\mu \times 1200\mu$, protomerite 50μ in length; cysts undescribed. From the figures given by Magalhães and Frenzel it seems quite probable that *G. serpentula* is a synonym of *G. blaberæ*, leaving but two species of gregarines known from the roaches of the world at present.

Gregarina acheta-abbreviata Leidy. Fig. 5.

Gregarina acheta-abbreviata Leidy, in part, 1853, p. 238, pl. 11, f. 34; Crawley, 1903a, p. 45, pl. III, f. 35; Beach Haven, New Jersey, from *Acheta abbreviata*: idem, 1903b, p. 639-641; idem, 1907, p. 220, pl. XVIII, f. 1; Beach Haven, New Jersey, and Wyncote, Pennsylvania, from *Gryllus abbreviatus*.

Epimerite undescribed; sporont short and broad, protomerite almost spherical, deutomerite rounded posteriorly; average P. $200\mu \times 150\mu$, D. $225\mu \times 300\mu$; cysts spherical, about 250μ , with a gelatinous envelope; sporocysts 2 to 5, elongate, reaching the length 1000μ , (Crawley, 1907, l.c.), sporocysts cylindrical, tapering slightly at each end, ends broadly rounded, $4.5\mu \times 2.3\mu$. Taken by the writer at Douglas Lake, Michigan, July, 1913, from *Gryllus americanus*.

Gregarina longiducta Ellis. Figs. 26-29.

Gregarina longiducta Ellis, 1913c, p. 78-82, f. 1-8; Douglas Lake, Michigan, from *Ceuthophilus latens* and *Ceuthophilus maculatus*.

Epimerite short and digitiform, about equalling the protomerite of a cephalont in length; sporont short and broad; average P. $200\mu \times 170\mu$, D. $200\mu \times$

230 μ ; cysts spherical with a gelatinous envelope, 200 μ to 300 μ ; sporoducts four or rarely five, at one pole, length when everted enormous, reaching 3500 μ ; sporocysts barrel-shaped, hexagonal in profile, with rounded edges, 3 μ x6.5 μ . A species much like *G. achetae-abbreviata* from which it differs in the size of the sporocysts, the enormously long sporoducts, and the polar arrangement of the sporoducts.

Gregarina consobrina sp. nov. Figs. 23-25.

Epimerite short, simple and digitiform, its length about one-third that of the protomerite of the cephalont; sporont short and globose; protomerite hemispherical, not as wide as the deutomerite; length of the protomerite about one-half of its width and one-fifth of the total length; deutomerite broadly oval in outline, its maximum width about equalling its length; cysts spherical, with a thick, outer, gelatinous envelope and a thin, dense, inner envelope, average cysts 250 μ to 300 μ ; sporoducts four to six in number, all in one hemisphere, very long, averaging 900 μ to 1200 μ in length; sporocysts cylindrical, slightly rounded at each end, in chains when first discharged, 3.2 μ x8 μ ; maturation period in water at room temperature during October, six days or more; average sporonts 600 μ in length, P. 130 μ x300 μ , D. 470 μ x450 μ ; host, *Ceuthophilus valgus* Scudder, (det. Prof. T. D. A. Cockerell), collected in Boulder Canon, near Boulder, Colorado, at an altitude of about 6,500 feet, October 5, 1913.

This species, *G. achetae-abbreviata* Leidy, and *G. longiducta* Ellis are to be regarded as a species group since they are so closely related yet each presents a different combination of characters. *G. consobrina* Ellis differs from *G. longiducta* Ellis in the position of the sporoducts, these being all in one hemisphere although not closely grouped about the pole; in the length of the sporoducts, which are about one-third as long as those of the latter; and in the shape of the sporont, this being much more globose and the protomerite less distinct. From *G. achetae-abbreviata* Leidy *G. consobrina* differs in shape of sporont, size of sporocyst, lack of orange color in cyst, as well as type of host.

Gregarina rigida (Hall). Fig. 13.

Hirmocystis rigida Hall, 1907, p.1-26, f. 1-11, 21; Lincoln, Nebraska, from *Melanoplus differentialis*, *M. femur-rubrum*, *M. atlantis*, Canon City, Colorado, from *M. bivittatus*, *M. differentialis*, *M. angustipennis*: Hall 1912, p. 337; Canon City, Colorado, from *M. coloradensis*, Boulder, Colorado, Colorado Springs, Colorado, Bethesda, Maryland: Ellis, 1913a, p. 464; Boulder, Colorado, from *Brachystola magna*.

Gregarina melanopli Crawley, 1907, p. 223, pl. XVIII, f. 6-9; Wyncote, Pennsylvania from *Melanoplus femoratus*: Ellis, 1913c, p. 82-83; Douglas Lake, Michigan, from *Melanoplus luridus*, *M. femur-rubrum*; *M. bivittatus*.

Epimerite short and digitiform; sporont short and broad, both protomerite and deutomerite rounded, average P. 130 μ x150 μ , D. 140 μ x570 μ ; cysts spherical, 300 μ to 400 μ , covered by a gelatinous envelope,

20 μ to 200 μ , usually orange in color; sporoducts 10 or more, exceeding the gelatinous envelope but a short distance; sporocysts in chains when first discharged, hyaline, barrel-shaped, rather hexagonal in outline, 5 μ ×8 μ ; both cysts and sporonts are usually yellow or even orange in color and the sporoduct-buds a brilliant orange just before the sporoducts are everted. This is the common gregarine of North American grasshoppers. Some little confusion concerning the name of this species has arisen as the result of the almost simultaneous publication of the descriptions of *Hirmocystis rigida* Hall and *Gregarina melanopi* Crawley, here considered as synonymous. The original diagnoses of both species were without descriptions of the cysts and their dehiscence. Hall pointed out (1912, p. 337) that the two species were to be regarded as synonyms. The writer, (1913c) described the cysts and their dehiscence for *G. melanopi* Crawley from material collected at Douglas Lake, Michigan, and since returning to Colorado has found the cysts of *Hirmocystis rigida* Hall to dehisce by sporoducts in the same manner; hence the name must stand *Gregarina rigida* (Hall).

Gregarina locustæ-carolinæ Leidy. Fig. 19.

Gregarina locustæ-carolinæ Leidy, in part, 1853, p. 239, pl. 11, f. 35-38; *Locusta carolina* L.: Crawley, 1907, p. 225, pl. XVIII, f. 13; from *Dissosteira carolina* (L.), Wyncote, Pennsylvania.

Stephanophora locustæ-carolinæ. Crawley, 1903a, p. 54, in part.

Epimerite globose, about half the length of the protomerite of the cephalont; sporont short and rounded, protomerite subglobose, deutomerite oval; largest individual seen (Crawley, 1907, p. 225), 350 μ ; cysts and dehiscence undescribed.

Gregarina passalicornuti Leidy. Figs. 12 and 16.

Gregarina passalicornuti Leidy, 1853, p. 238, pl. 11, Fig. 30-31; Ellis, 1913b; New Orleans, Louisiana, from *Passalus cornutus* Fab.

Epimerite undescribed; sporont distinctly longer than broad, rather cylindrical in outline, protomerite hemispherical, deutomerite cylindrical, usually narrowed near the middle; average P. 60 μ ×50 μ , D. 60 μ ×150 μ ; cysts and sporocysts unknown.

Gregarina guatemalensis Ellis. Fig. 15.

Gregarina guatemalensis Ellis, 1912c, p. 687, Fig. 6; Quirigua, Guatemala, from *Nelus interstitialis*

Epimerite undescribed; sporont short and broad, especially in the posterior portion of the deutomerite; protomerite subglobose; deutomerite cylindrical, widening rather abruptly near its posterior end; average P. 70 μ ×80 μ , D. 160 μ ×180 μ ; cysts and dehiscence undescribed.

Gregarina xylopi Crawley. Fig. 17.

Gregarina xylopi Crawley, in part, 1903a, p. 47, pl. III, f. 30; from *Xylopinus saperdioides*.

Epimerite undescribed; sporont somewhat elongate; protomerite elongate, distinctly narrowed near the middle, its length twice its width; pro-

tomerite cylindrical, its width about one-third its length; cysts and dehiscence undescribed; size not given in original diagnosis.

Gregarina grisea Ellis. Fig. 18.

Gregarina grisea Ellis, 1913b, p. 200, f. 1; New Orleans, Louisiana, from *Tenebrio castaneus* Knoch.

Epimerite undescribed; sporont short and ovoid; protomerite hemispherical, narrower than the deutomerite; deutomerite oval, its posterior margin broadly rounded; average P. $60\mu \times 50\mu$, D. $100\mu \times 370\mu$.

Gregarina microcephala Leidy.

Gregarina microcephala Leidy, 1889, p. 11, 1 Fig.; from *Hoplocephala bicornis*.

This is known only from the original diagnosis. Since its position is very uncertain Leidy's description is copied here.

"In some little green beetles, *Hoplocephala bicornis*, one of the Tenebrionidæ, I found a number of gregarines remarkable for the small size of the head and hence the species may be named *Gregarina microcephala*. The body is clavate; the head like a watch crystal with a little ball at the summit. Length 0.35 mm. by 0.1 wide; head 0.012 long by 0.04 wide. It bears a close resemblance to *Echinocephalus hispidus* of Schneider, found in *Lithobius forcipatus*, but in the one described I at no time found digitiform appendages to the head."

The host of this species is now known as *Arrhenoplita bicornis* (Olivier).

Gregarina scarabeirelicti Leidy.

Gregarina sp. Leidy, 1851a, p. 208; from the larvæ of a large lamellicorn insect.

Gregarina scarabeirelicti Leidy, 1851b, p. 287; from larvæ of *Scarabeus relictus*.

This species and the following one, *G. melalonthæbrunneæ* Leidy, are known only from the original diagnoses, which are incomplete and without figures. Until these species are redescribed their position and validity are doubtful. Leidy's diagnoses are copied here.

"Body white, cylindro-fusiform. Superior division presenting four sides of a hexagon, subacute. Nuclear body of inferior division transparent, globular or elliptical, containing several coarse granules. Length from 1-66th to 1.25 lines; head 1-400th inch to 1-133d inch long by 1-285th inch to 1-111th inch broad. Anterior portion of inferior division 1-200th inch to 1-86th inch broad; posterior portion 1-666th to 1-250th inch broad. —".

Gregarina melalonthæbrunneæ Leidy.

Gregarina melalonthæbrunneæ Leidy, 1856, p. 47; from *Melalonthæbrunneæ*.

"Body oblong oval; head oblate spheroidal, slightly elevated at the summit. Single and in pairs. Length of body .405 mm., breadth .252 mm.; length of head .108 mm., breadth .144 mm."

Gregarina statiræ Frenzel. Fig. 14.

Gregarina statiræ Frenzel, 1892, p. 234-286, t. VIII, f. 1-15; Cordoba, Ar-

gentine Republic, from *Statira unicolor* Blanch.

Epimerite short, simple, conic; cephalonts and free sporonts ovoid; sporonts in association globose; protomerite hemispherical to subglobose, its length about one-fourth of the total length, width of the protomerite less than that of the deutomerite, in large sporonts about one-half the width of the deutomerite; protomerite of satellite quite compressed; cysts and sporocysts unknown; large sporonts $300\mu \times 350\mu$.

Gregarina bergi Frenzel. Figs. 38-39.

Gregarina bergi Frenzel, 1892, p. 286-298, f. 16-19; Cordoba, Argentine Republic, from *Corynetes ruficollis*.

Epimerite simple, styloform, enlarged near the base so that it is arrow-head-shaped in profile, its length greater than that of the protomerite of the cephalont, its greatest width about one-half that of the protomerite; sporonts ovoid; protomerite hemispherical, almost as wide as the deutomerite, length of the protomerite about one-fourth of the total length; posterior margin of the deutomerite broadly rounded; cysts and sporocysts unknown; average individuals $90\mu \times 300\mu$. This gregarine has been taken by Wellmer, 1912, in Prussia from *Corynetes violaceus* L. He reports it as forming associations.

Gregarina elateræ Crawley. Fig. 10-11.

Gregarina elateræ Crawley, 1903a, p. 46, pl. I, f. 11; Wyncote, Pennsylvania, from *Elater* sp. larvæ.

Hirmocystis ovalis Crawley, 1903a, p. 50, pl. I, f. 5-6; from larvæ of beetles, doubtfully identified as *Cucujidæ*.

Epimerite globose to ovoid, almost equalling the length of the protomerite of the cephalont in diameter; cephalont ovoid; sporont rather cylindrical, both protomerite and deutomerite broadly rounded; protomerite hemispherical about one-fourth as long as the deutomerite; deutomerite cylindrical, a little broader at its junction with the protomerite than the protomerite; cysts and sporocysts undescribed; no associations observed; maximum length as given by Crawley, 70μ .

Gregarina termitis Leidy. Fig. 6.

Gregarina termitis Leidy, 1881, p. 441, pl. 52, f. 27; Porter, 1897, p. 65, pl. 6, f. 73-76; Cambridge, Mass. from *Termes flavipes*.

Epimerite undescribed; sporont short, distinctly longer than broad, protomerite oval to subglobose, deutomerite ovoid to cylindrical; average P. $25\mu \times 170\mu$, D. $30\mu \times 400\mu$, cysts and sporocysts unknown. The writer has taken this species at Boulder, Colorado from *Termes lucifugus* during 1912 and 1913.

Gregarina calverti Crawley. Fig. 4.

Gregarina calverti Crawley, 1903a, p. 48, pl. II, f. 19-21; Wyncote, Pennsylvania, from *Lysiopetalum lactarium*; idem. 1903b, p. 638, pl. XXX, f. 15.

Epimerite undescribed; sporont elongate and cylindrical, protomerite short, oval in outline, about one-twentieth as long as the deutomerite, somewhat more globose in young sporonts equalling about one-sixth of the length

of the deutomerite, deutomerite elongate and cylindrical, tapering posteriorly in young sporonts; cysts spherical, about 300μ in diameter; sporocysts barrel-shaped, $5\mu \times 13\mu$; average sporonts 1000μ .

Gregarina sp.

Gregarina sp. Ritter, Proc., Cal. Acad. Sci., ser. 2, 4, p. 39-85, 1893. This description was not seen by the writer.

Gigaductus Crawley, 1903a, p. 633.

Type—*G. parvus* Crawley, 1903a, p. 633, pl. XXX, f. 10-13; from *Harpalus caliginosus* Fab.—*Coleoptera*.

Gigaductus parvus Crawley. Fig. 8.

Gigaductus parvus Crawley, 1903a, p. 633, pl. XXX, f. 10-13; Wyncote, Pennsylvania from *Harpalus caliginosus* Fab.: Ellis, 1913a, p. 465; Vincennes, Indiana, from *Harpalus pennsylvanicus* Dej.

Epimerite undescribed; sporont longer than wide though not greatly elongate, oval in outline with a distinct constriction at the junction of the protomerite and deutomerite; protomerite subglobose; deutomerite ovoid, tapering noticeably toward the posterior end; average P. $70\mu \times 45\mu$, D. $80\mu \times 160\mu$; cysts spherical, about 200μ in diameter, dehiscence by one, large, short sporoduct; sporocysts cylindrical, $25\mu \times 12\mu$.

Gigaductus kingi (Crawley). Fig. 7.

Gregarina kingi Crawley, 1907, p. 221, pl. XVIII, f. 10-12; from *Gryllus abbreviatus* Serv.

Epimerite undescribed; sporont longer than wide; protomerite of primitive knob-shaped, widest in its anterior half, deeply constricted near the middle; protomerite of the satellite subglobose; deutomerite oval in outline; average P. $60\mu \times 40\mu$, D. $60\mu \times 120\mu$; cysts spherical or oval, about 100μ in diameter, dehiscence by one large, rather long sporoduct; sporocysts barrel-shaped, $3\mu \times 5\mu$.

Gamocystis A. Schneider, 1875, p. 587.

Type—*G. tenax* A. Schneider, 1875, p. 587, t. 19, f. 10-13, t.21.f.6; from *Ectobia lapponica* (L.).—*Orthoptera*.

This genus is without a known representative in our fauna at present.

ACTINOCEPHALIDÆ

Dehiscence of cysts by simple rupture; sporocysts biconic or navicular to crescentic; epimerite variable; sporonts not forming associations. As here defined this family includes both the *Actinocephalidæ* and *Menosporidæ* of Leger. The epimerite becomes highly specialized in some species of this family, yet the entire gamut of possibilities is run from the simple to the extremely elaborate. Three types are represented if typical species be chosen: (1) epimerite simple and styliform—*Styllocystis*; (2) styliform with a circular, elevated and divided, basal portion—*Pyxinia*; (3) epimerite

consisting of a circular elevated and divided portion, with a central concavity, suggestive of the disappearance of the styliform portion of the other two types—*Menospora*. An effort to divide the family according to these three types of epimerite is unsatisfactory, however, since the various combinations of these epimerite characters, as regards presence and absence, and degree, intergrade. A key to the genera, although perhaps somewhat artificial, is possible on epimerite characters.

- a. Protomerite regular, not divided.
- b. Epimerite simple.
 - c. Epimerite rounded, hemispherical; protomerite of the cephalont much compressed and elevated around the base of the epimerite like a collar.....*Amphoroides*
 - cc. Epimerite styliform.
 - d. Epimerite at first short and styliform, but becoming rounded and button-shaped as the cephalont develops *Steinina*
 - dd. Epimerite not becoming button-shaped.
 - e. Epimerite simple styliform, often curved.*Stylocystis*
 - ee. Epimerite conical, arrowhead-shaped in profile....
..... *Pileocephalus*
 - bb. Epimerite not simple.
 - f. Carried by a much produced portion of the protomerite.
 - g. With retrose spine-like processes; styliform to subglobose *Geniorhynchus*
 - gg. Without retrose spine-like processes.
 - h. Apical portion with digitiform processes.
 - i. Apex concave, with a marginal row of curved processes.....*Menospora*
 - ii. Apex convex, with six to eight marginal digitiform processes.....*Hoplorhynchus*
 - hh. Without apical digitiform processes; a rounded marginal portion in the center of which is an elevated cup-shaped portion with a scalloped edge; central portion evertible.....*Phialoides*
 - ff. Anterior portion of the protomerite of the cephalont slightly if at all produced.
 - j. Septum wanting; epimerite disk-shaped to subglobose, its margin scalloped deeply.....*Schneideria*
 - jj. Septum present, protomerite and deutomerite distinct.
 - k. Epimerite consisting of a central elevated portion surrounded at its base by a marginal elevated or divided portion.

- l. Central portion rounded, hemispherical, marginal portion rounded and undivided.....
..... *Discorhynchus*
- ll. Central portion pointed and styliform.
 - m. Basal portion scalloped.....*Pyxinia*
 - mm. Basal portion subglobose, produced into horizontal or slightly recurved teeth....
..... *Beloides*
- kk. Epimerite without a central elevated portion.
 - n. Deutomerite not divided by septa.
 - o. Epimerite short, with a series of long hair-like filaments.....*Bothriopsis*
..... *Coleorhynchus*
..... *Legeria*
 - oo. Epimerite without long filaments but with short digitiform processes.
 - p. Basal portion of the epimerite longer than the digitiform processes, cylindrical to flask-shaped.....
..... *Amphorcephalus*
 - pp. Basal portion equal to or shorter than the digitiform processes.
 - q. Digitiform processes free and well separated ...*Actinocephalus*
 - qq. Digitiform processes placed close together, more or less united at the base*Stephanophora*
 - ooo. Epimerite without long filaments, consisting of button-shaped or subglobose mass deeply fluted.
 - r. Basal portion of the lobes rounded..
..... *Anthorhynchus*
 - rr. Basal portion of the lobes pointed and recurved*Stictospora*
 - nn. Deutomerite divided by several septa; epimerite subglobose with recurved hooks.....
..... *Tæniocystis*
 - aa. Protomerite produced and divided equatorially so that the whole has somewhat the appearance of half-raised umbrella; epimerite consisting of a circular series of short digitiform processes carried on a narrowed portion of the protomerite....*Sciadiophora*
Amphoroides Labbe, 1899, p. 20.
Amphorella Leger, 1892, p. 132. Preoccupied.

Type—*A. polydesmi* (Leger)=*Amphorella polydesmi* Leger, 1892, p. 132, t.10, f.9-14; from *Polydesmus complanatus* (L.),—Diplopoda.

Amphoroides polydesmivirginiensis (Leidy). Fig. 36.

Gregarina polydesmivirginiensis Leidy, 1853, p. 238, pl. 10, f.23-29; *Amphoroides polydesmivirginiensis*, Crawley, 1903a, p. 45, pl. II, f.25; Wyncote, Pennsylvania and Raleigh, North Carolina, from *Polydesmus virginiensis*.

Epimerite undescribed; protomerite button-shaped to subglobose, small, and narrower than the deutomerite, greatest length of the protomerite not exceeding one-tenth of the length of the deutomerite; deutomerite elongate, rounded posteriorly, widened in the anterior half; epicyte thick; cysts and sporocysts unknown; average sporonts 400 μ .

Amphoroides fontariae Crawley. Fig. 37.

Amphoroides fontariae Crawley, 1903a, p. 53, pl. I, f.12-14; Wyncote, Pennsylvania, and Raleigh, North Carolina, from *Polydesmus* sp. and *Fontaria* sp.

Epimerite undescribed; sporont somewhat ovoid in shape, protomerite subglobose, its maximum width less than that of the deutomerite, its length one-fourth or less of the length of the deutomerite; deutomerite oval in outline, often widened in its anterior half; average sporonts about 170 μ ; sporocysts and cysts unknown. The writer has taken this species from specimens of *Polydesmus* sp. collected by Mr. S. A. Rohwer at East Falls Church, Virginia, in May, 1913.

Steinina Leger et Duboscq, 1904, p. 352.

Type—*S. ovalis* (Stein)=*Stylorhynchus ovalis* Stein, 1848, p. 182-223; from *Tenebrio molitor* L. larvæ—*Coleoptera*.

This species, *S. ovalis* (Stein), or others of the same genus, should be looked for in North America since the host and other closely related species are found in our fauna.

Stylocystis Leger, 1899, p. 526.

Type—*S. præcox* Leger, 1899, p. 526-533; from *Tanytus* sp. larvæ—*Coleoptera*.

Stylocystis ensiferus (Ellis). Fig. 34.

Stylocephalus ensiferus Ellis, 1912c, p. 686, f.5; Quirigua, Guatemala, from *Leptochirus edax* Sharp.

Epimerite simple and styliform, its length about equal to that of the protomerite of the cephalont; sporont ovoid, the deutomerite broadly rounded posteriorly, protomerite subglobose, deutomerite cylindrical; average sporonts 50 μ ; cysts and sporocysts unknown.

Pilcocephalus A. Schneider, 1875, p. 591.

Type—*P. chinensis* A. Schneider, 1875, p. 592, t.16, f.21-24; from *Mystacides* sp. larvæ—*Trichoptera*.

Geniorhynchus A. Schneider, 1875, p. 594.

Type—*G. monnieri* A. Schneider, 1875, p. 595, t.20, f.21-27; from *Libellula* sp. nymphs—*Odonata*.

Geniorhynchus æshnæ Crawley. Fig. 41.

Geniorhynchus æshnæ Crawley, 1907, p. 227, pl. XVIII, f.4; Southeastern Pennsylvania, from nymphs of *Aeshna constricta* Say.

Epimerite subglobose, carried by an elongated portion of the protomerites, with numerous short, spine-like processes directed posteriorly; both protomerite and deutomerite resembling truncated cones with their bases together; deutomerite according to Crawley often constricted posteriorly; size given as 420 μ ; cysts and sporocysts not known.

Menospora Leger, 1892, p. 151.

Type—*M. polyacantha* Leger, 1892, p. 151, t.19, f.1-5; from *Agriion puella* (L.) nymphs—*Odonata*.

Hoplorhynchus Carus, 1863, p. 570.

Type—*H. oligacanthus* (Siebold)=*Gregarina oligacantha* Siebold, 1839, t.3; from *Calopteryx virgo* (L.)—*Odonata*.

Phialoides Labbe, 1899, p. 24.

Phialis Leger, 1892, p. 135. Preoccupied.

Type—*P. ornata* (Leger)=*Phialis ornata* Leger, 1892, p. 135, t.13, f.4-12; from *Hydrophilus piceus* (L.) larvæ—*Coleoptera*.

Schneideria Leger, 1892, p. 153.

Type—*S. mucronata* Leger, 1892, p. 153, t.2, f.7-13; from *Bibio marci* (L.) larvæ—*Diptera*.

Discorhynchus Labbe, 1899, p. 20.

Discocephalus Leger, 1892, p. 134. Preoccupied.

Type—*D. truncatus* (Leger)=*Discocephalus truncatus* Leger, 1892, p. 134, t.15, f.10-12; from *Sericostoma* sp. larvæ—*Trichoptera*.

Pyxinia Hammerschmidt, 1838 p. 35.

Asterophora Leger, 1892, p. 129.

Type—*P. rubecula* Hammerschmidt, 1838, p. 357, t.4, f. a-g; from *Dermestes lardarius* L.—*Coleoptera*.

Pyxinia crystalligera Frenzel. Fig. 43-44.

Pyxinia crysatlligera Frenzel, 1892, p. 314-332, f. 34-50; Cordoba, Argentine Republic, from *Dermestes vulpinus* Fab. and *Dermestes peruvianus* Castelnau, and larvæ of the latter.

Epimerite consisting of a circular basal portion with a fluted margin and a central styliform portion, the length of the styliform portion exceeding one-half the length of the protomerite of the cephalon; sporont somewhat elongate, protomerite globose, narrower than the widest portion of the deutomerite, deutomerite broad just posterior to the protomerite; average sporonts 90 μ ×250 μ .

Beloides Labbe, 1899, p. 26.

Xiphorhynchus Leger, 1892, p. 137. Preoccupied.

Type—*B. firmus* (Leger)=*Xiphorhynchus firmus* Leger, 1892, p. 138, t.17, f.1-4; from *Dermestes lardarius* L.—*Coleoptera*.

Bothriopsis A. Schneider, 1875, p. 596.

Type—*B. histrio* A. Schneider, 1875, p. 596, pl. XXI, f.8-13; from *Hydaticus cinereus*,—*Coleoptera*.

Bothriopsis histrio A. Schneider. Fig. 42.

Bothriopsis histrio Schneider, 1875, p. 596, pl. XXI, f.8-13; Crawley, 1903a, p. 54-55, pl. II, f.15-18; Wyncote, Pennsylvania, from *Hydaticus cinereus* larvæ, *Colymbetes fuscus* and *Acilius sulcatus*.

Epimerite consisting of a short button-shaped portion from the margin of which are six or more long hair-like filaments; protomerite of the cephalon subglobose anteriorly and cylindrical posteriorly; deutomerite of cephalon ovoid; sporont variable and very active changing shape readily, in expanded individuals the protomerite is subglobose with a cup-shaped depression posteriorly into which the conical anterior end of the deutomerite fits, deutomerite, aside from the portion included by the protomerite, elongate and conical; sporonts reach the length of 500μ ; cysts spherical, about 400μ in diameter, dehiscing by simple rupture; sporocysts biconic, $5\mu \times 7\mu$.

Coleorhynchus Labbe, 1899, p. 23.

Coleophora A. Schneider, 1885, p. 94. Preoccupied.

Type—*C. heros* (A. Schneider)=*Coleophora heros* A. Schneider, 1885, p. 95, t.25; from *Nepa cinerea* L.—*Hemiptera*.

Although the type of epimerite for this genus has not been described it is placed in the key with *Bothriopsis* because of the aquatic host.

Legeria Labbe, 1899, p. 24.

Dufouria A. Schneider, 1875, p. 595. Preoccupied.

Type—*L. agilis* (A. Schneider)=*Dufouria agilis* A. Schneider, 1875, p. 595, t.22, f.1-6; from *Colymbetes* sp. larvæ—*Coleoptera*.

Legeria terpsichorella sp. nov. Fig. 30.

Epimerite not seen; sporonts extremely active constantly changing the shape of the anterior three-fifths of the body and proceeding rather rapidly in a serpentine path as a result, the protomerite often being bent almost forty-five degrees from the main axis of the body; expanded individual with a protomerite equal to or longer than the deutomerite, the anterior fourth of the protomerite hemispherical to subglobose, below which is an elevated flange-like portion, remaining two-thirds cylindrical, the posterior portion with a cup-shaped depression some 60μ deep into which the anterior conical portion of the deutomerite fits; deutomerite excepting the portion included by the protomerite ovoid, rather sharply rounded posteriorly; average sporonts about 720μ in length; length of the deutomerite to the external junction with protomerite 320μ , of the anterior conical portion of the deutomerite 96μ , of the protomerite to the flange portion 320μ , from flange to anterior end 80μ ; width of deutomerite 145μ , of the flange portion of the protomerite 175μ ; epicyte thin and flexible; sarcocyte scarcely visible; nucleus seen only with the use of reagents; endocyte dense and homogeneous, of a light brown color; cysts and sporocysts not seen.

Host, *Hydrophilus* sp., Douglas Lake, Michigan, July, 1913.

Amphorellus Ellis, 1913a, p. 462.

Type—*A. amphorellus* Ellis, 1913a, p. 463, f. 1-2; from *Scolopendra heros* Girard—*Chilopoda*.

Amphorocephalus amphorellus Ellis. Figs. 51-52

Amphorocephalus amphorellus Ellis, 1913a, p. 463, f. 1-2; Boulder, Colorado, from *Scolopendra heros* Girard.

Epimerite flask-shaped with a marginal row of small digitiform processes at its anterior end, its length greater than that of the protomerite of the cephalont; protomerite with a constriction near the middle; deutomerite of the cephalont elongate and conical, broadest near its anterior end, where its maximum width is twice that of the protomerite; deutomerite of the sporont elongate and cylindrical, rather sharply and abruptly pointed at its posterior end; sporonts reaching the length of 1,000 μ ; P. 60 μ x50 μ , D. 60 μ x950 μ ; cysts unknown.

Amphorocephalus actinotus (Leidy). Fig. 53.

Gregarina actinota Leidy, 1889, p. 10, f.1; from *Scolopocryptops sexspinosus*.

Hoplorhynchus actinotus, Crawley, 1903a, p. 55, pl. III, f.36-37; Wyncote, Pennsylvania, Raleigh, North Carolina, and Wallingford, Pennsylvania, from *Scolopocryptops* sp.

Hoplorhynchus scolopendras Crawley, 1903b, p. 636, pl. XXX, f.19; Raleigh, N. C. from *Scolopendra woodi* Meiner.

Epimerite elongate, flask-shaped, bearing at its anterior end a series of small digitiform processes carried by four horizontal lobes, length of the epimerite equal to from one-half to one fourth of the total length of the cephalont; protomerite hemispherical to subglobose; deutomerite elongate, conical and pointed posteriorly, its maximum width about one-third of its length; size, as given by Leidy 600 μ for the cephalont, by Crawley, 485 μ for the sporont; cysts unknown.

Actinocephalus F. Stein, 1848, p. 196.

Stephanophora Leger, 1892, p. 127.

Type—*A. lucani* F. Stein, 1848, t. 9, f. 33; from Lucanid beetle.

It is to be noted that *Stephanophora* Leger, was invalid since it included the single species *Actinocephalus lucani* Stein (redescribed by Leger as *Stephanophora radiosa* Leger), the type of Stein's genus *Actinocephalus*. Leger, 1892, recognized the synonymy of *Actinocephalus lucani* Stein with his species *Stephanophora radiosa*, but by its removal from the genus of Stein (wrongly ascribed to Schneider by Leger, 1892, p. 141), the genus *Actinocephalus* Stein was left without a species included in its original description. This situation renders the name *Actinocephalus* as restricted by Leger, l. c., and Labbe, (1899, p. 25), invalid. In restoring the name *Actinocephalus* to its type *A. lucani* Stein, *Actinocephalus* of authors stands without a name. Since *Stephanophora* Leger and *Actinocephalus* of authors are so closely related it seems best to consider them synonymous, avoiding

the confusion attendant to the substitution of a new name. Both epimerite and sporocyst characters of *Stephanophora* and *Actinocephalus* intergrade.

Actinocephalus pachydermus (Crawley). Figs. 54-55.

Stephanophora pachyderma Crawley, 1907, p. 226, pl. XVIII, f. 2-3; Wyncote, Pennsylvania, from *Dissosteira carolina* (L.)

Gregarina locustæ-carolinæ Leidy, in part, 1853, p. 239, pl. 11, f. 37-38.

Stephanophora locustæ-carolinæ, Crawley, in part, 1903a, p. 54.

Epimerite subglobose, bearing at its apex a marginal row of digitiform processes; protomerite somewhat hemispherical with the epicyte slightly produced to receive the epimerite; deutomerite of the cephalont elongate but rather broad; sporont oval in outline, protomerite short and hemispherical, its length about one-fourth of the total length; epicyte very thick in both cephalont and sporont; sporonts reaching the length of 500μ ; cysts unknown. It seems quite probable that the undescribed gregarine figured by Hall, (1907, f. 13) from *Chimarocephalus viridifasciata* taken at Lincoln, Nebraska, was a sporont of this species.

Actinocephalus zophus (Ellis) Fig. 49.

Stephanophora zopha Ellis, 1913b, p. 201, f. 2; New Orleans, Louisiana, from *Nyctobates barbata* Knoch.

Gregarina xylopinii Crawley, in part, 1903a, p. 47, f. 29; from *Xylopinus saperdioides*.

Epimerite short and subcylindrical, with an apical row of marginal digitiform processes; protomerite subglobose, its diameter equal to or a little greater than the length of the epimerite; deutomerite elongate, cylindrical, pointed posteriorly; sporont elongate and cylindrical, pointed posteriorly, length of the protomerite 8 to 12 in the length of the deutomerite; sporonts reaching length of 1600μ ; cysts unknown. The writer has taken this gregarine from specimens of *Alobates pennsylvanicus* deGeer collected at East Falls Church, Virginia in May, 1913 by Mr. S. A. Rohwer.

Actinocephalus crassus (Ellis). Fig. 40.

Stephanophora crassa Ellis, 1912c, p. 688, f. 7; Quirigua, Guatemala, from *Leptochirus edax* Sharp.

Known only from the sporont; general shape ovoid with the posterior portion of the deutomerite narrowed and conical; protomerite hemispherical, its length equal to about one-third of the total length; deutomerite broad in the anterior half, narrowed rather abruptly in the posterior half to a rounded cone; epicyte thick.

Actinocephalus harpali (Crawley). Fig. 46.

Gregarina harpali Crawley, 1903a, p. 49-50, pl. I, f. 1-4; Wyncote, Pennsylvania from *Harpalus caliginosus*.

Actinocephalus harpali, Crawley, 1903b, p. 637-638, pl. XXX, f. 14.

Epimerite undescribed; sporont ovoid; protomerite hemispherical its length about one-sixth of the total length and about one-half of its own width; deutomerite ovoid; sporonts reaching the length of 1200μ . Cysts about 500μ in diameter, covered with a thick gelatinous envelope, dehiscing

by simple rupture; sporocysts $7.5\mu \times 9\mu$, described by Crawley as, "diamond shaped in longitudinal and hexagonal in transverse section."

Actinocephalus discali (Crawley). Fig. 50.

Gregarina discali Crawley, 1903a, p. 47, pl. I, f. 7-10; Wyncote, Pennsylvania, from *Discalus ovalis*.

Epimerite undescribed; sporont elongate, posterior end of the deutomerite tapering and pointed; protomerite pentagonal in outline, as wide or slightly wider than the deutomerite, its length about one-thirteenth of the total length in large sporonts; cysts and sporocysts unknown. This gregarine is placed in the genus *Actinocephalus* because of the general shape of the sporont and the coleopteran host; it was removed from the genus *Gregarina* since the sporonts do not form associations. The grouping of large numbers of sporonts with the posterior ends of their deutomerites touching can not be considered an association in the sense of a Gregarinid association, and has also been observed for species of *Stylocephalus* and *Actinocephalus*.

Actinocephalus dujardini A. Schneider. Fig. 45.

Actinocephalus dujardini A. Schneider, 1875, p. 589, pl. 16, f. 9-20; Crawley, 1903a, p. 55; from *Lithobius forcipatus*.

Epimerite subglobose with a short neck, bearing a marginal row of about twenty short, rigid, recurved, tooth-like processes at its anterior end; protomerite subglobose to cuboidal; its length equal to half or more of the length of the deutomerite; deutomerite rather broad, conical; size small.

Actinocephalus americanus Crawley. Fig. 56.

Actinocephalus americanus Crawley, 1903b, p. 636, pl. XXX, f. 22; Wyncote, Pennsylvania, from *Galerita bicolor* Drury.

This gregarine was described from a single specimen, $200\mu \times 45\mu$, protomerite 35μ long. Crawley states that it is probably "only sporadically present in *Galerita*, and that its usual host is some other animal." There exists but this single record of this species.

Actinocephalus brachydactylus sp. nov. Figs. 31-33.

Epimerite very short, composed of a circular row of eight short digitiform processes united basally; protomerite globose to dome-shaped, in the cephalonts slightly broader than the deutomerite; deutomerite subcylindrical, tapering gradually towards the posterior end which is broadly rounded; average cephalont 320μ in length, protomerite $80\mu \times 80\mu$, deutomerite $75\mu \times 240\mu$; sporonts reaching the length of 500μ ; cysts not seen. Host, nymphs of *Aeshna* sp., Douglas Lake, Michigan. Taken July, 1913.

Anthorhynchus Labbe, 1899, p. 19.

Anthocephalus A. Schneider, 1887, p. 69. Preoccupied.

Type—*A. sophia* (A. Schneider) = *Anthocephalus sophia* A. Schneider, 1887, p. 69, t. 10, f. 11-17; from *Phalangium opilio* L.—*Phalangidea*.

Anthorhynchus cratoparis (Crawley). Fig. 47.

Asterophora cratoparis Crawley, 1903a, p. 54, pl. II, f. 23; Swarthmore, Pennsylvania, from *Cratoparis lunatus*.

Epimerite spherical, deeply fluted, borne by a short elevation from the anterior portion of the protomerite; protomerite subglobose; deutomerite in the form of a truncated cone, somewhat elongate and narrowed at the anterior end where it joins the protomerite; length given as 540μ ; cysts undescribed.

Authorhynchus philicus (Leidy). Fig. 48.

Gregarina philica Leidy, 1889, p. 9, 1 f.; from *Nyctobates pennsylvanica*.

Asterophora philica, Crawley, in part, 1903a, p. 53, pl. III, f. 31-32.

Epimerite spherical, deeply fluted; protomerite subglobose to cuboidal, about one-ninth the length of the deutomerite; deutomerite elongate, sub-cylindrical, tapering to a point at the posterior end; length as given by Crawley, 300μ ; cysts undescribed.

Authorhynchus boletophagi (Crawley). Fig. 57.

Gregarina boletophagi Crawley, 1903a, p. 47, pl. II, f. 26-28; Swarthmore, Pennsylvania, from *Boletophagus cornutus*.

Epimerite undescribed; sporont subcylindrical, protomerite oval in outline with a short dome-shaped portion at the anterior end, length of the protomerite a little more than one-fourth of the total length, deutomerite regularly cylindrical excepting the extreme posterior end which tapers rather abruptly so as to form a truncated cone. This species has been transferred to this genus from *Gregarina* although neither cysts nor epimerite are known, because it is not found in association, and because the anterior portion of the protomerite is suggestive of the slightly produced protomerites of other species of the genus *Authorhynchus*, which bear the epimerites. It is to be regarded as a provisional determination only.

Stictospora Leger, 1893, p. 117.

Type—*S. provincialis* Leger, 1893, p. 129-131; from *Melolontha* sp. larvæ—*Coleoptera*.

Tæniocystis Leger, 1906, p. 307.

Type—*T. mira* Leger, 1906, p. 307-329; from *Ceratopogon solstitialis* Winn., larvæ—*Diptera*.

Sciadiophora Labbe, 1899, p. 17.

Lycosella Leger, 1896, p. 36. Preoccupied.

Type—*S. phalangii* (Leger) = *Lycosella phalangii* Leger, 1896, p. 36, t. 3, f. 1-15; from *Phalangium crassum* Duf.—*Phalangidea*.

The writer has opened the alimentary canal of perhaps two hundred *Phalangidea* from Douglas Lake, Michigan, and from Boulder, Colorado, without finding any gregarine infection, although *S. phalangii* (Leger) and related species are reported as very abundant in the *Phalangidea* of Europe.

ACANTHOSPORIDÆ

Dehiscence of cysts by simple rupture; sporocysts with spines; sporonts always solitary. No species referable to this family have

been taken as yet in the new world. The genera may be separated by the following key:

- a. Epimerite without lateral recurved processes or long filaments; spines at both the equator and the poles of the sporocysts. *Acanthospora*.
- aa. Epimerite with either lateral recurved processes or long filaments.
 - b. Epimerite with lateral recurved processes.
 - c. Sporocysts with spines only at the poles.....*Corycella*
 - cc. Sporocysts with spines at both the equator and poles. *Ancyrophora*
 - bb. Epimerite with long filaments; sporocysts with spines both at the poles and above and below the equator.....*Cometoides Acanthospora* Leger, 1892, p. 145.

Type—*A. pileata* Leger, 1892, p. 145, t. 15, f. 1-5; from *Omoplus* sp. larvæ—*Coleoptera*.

Corycella Leger, 1892, p. 144.

Type—*C. armata* Leger, 1892, p. 144, t. 16, f. 7-12; from *Gyrinus natator*—*Coleoptera*.

Ancyrophora Leger, 1892, p. 146.

Type—*A. gracilis* Leger, 1892, p. 146, t. 19, f. 11-13; from *Carabus auratus* L.,—*Coleoptera*.

Cometoides Labbe, 1899, p. 29.

Pogonites Leger, 1892, p. 148. Preoccupied.

Type—*C. crinitus* (Leger) = *Pogonites crinitus* Leger, 1892, p. 149, t. 18; from *Hydrobius* sp. larvæ—*Coleoptera*.

STYLOCEPHALIDÆ

Dehiscence of cysts by simple rupture with a pseudocyst; sporonts solitary; sporocysts subspherical but asymmetrical, united in chains usually black or dark brown; sporulation distinctly anisogamic. The species of this family are known only from Tenebrionid beetles*

- a. Epimerite cup-shaped, composed of a row of short digitiform processes surrounding a membranous portion.....*Lophocephalus*
- aa. Epimerite without digitiform processes.
 - b. Epimerite large and conical, carried by a short neck.....
..... *Cystocephalus*
 - bb. Epimerite small, carried by a long base.
 - c. Epimerite spherical or ovoid.....*Sphærorhynchus*
 - cc. Epimerite cylindrical and pointed, with a bulbous basal portion*Stylocephalus*

Lophocephalus Labbe, 1899, p. 31.

*The species *Stylocephalus caudatus* (Rössler) is probably referable to the genus *Stictospora* of the *Actinocephalidae*. This species is from a Phalangid host.

Lophorhynchus A. Schneider, 1882, p. 435. Preoccupied.

Type—*L. insignis* (A. Schneider) = *Lophorhynchus insignis* A. Schneider, 1882, p. 435, t. 13, f. 1-3, 5, 12, 13, 48, 50; from *Helops striatus* Fourc.—*Coleoptera*.

Cystocephalus A. Schneider, 1886, p. 99.

Oocephalus A. Schneider, 1886, p. 101.

Type—*C. algerianus* A. Schneider, 1886, p. 100, t. 27, from *Pimelia* sp.—*Coleoptera*.

Sphaerorhynchus Labbe, 1899, p. 32.

Sphaerocephalus A. Schneider, 1886, p. 100, Preoccupied.

Type—*S. ophioides* (A. Schneider) = *Sphaerocephalus ophioides* A. Schneider, 1886, p. 100, t. 28; from *Acis* sp.—*Coleoptera*.

Stylocephalus Ellis, 1912, p. 25.

Stylorhynchus Stein, 1848, p. 195. Preoccupied.

Type—*S. giganteus* Ellis, 1912, p. 25-27, f. 1-2; from *Eleodes* sp.—*Coleoptera*.

Stylocephalus giganteus Ellis. Figs. 58-59.

Stylocephalus giganteus Ellis, 1912a, p. 25-27, f. 1-2; Boulder, Colorado, from *Eleodes* sp.: Hall, 1912, p. 337-338; Amo, Colorado, from *Eleodes hispilabris* and *Eleodes* sp.

Epimerite rather styliform, basal bulbous portion less than half as long as the distal cylindrical portion; collar joining the epimerite to the protomerite almost, if not quite as long, as the epimerite proper and exceeding it in diameter; epimerite and collar exceeding the length of the protomerite of the cephalont; sporont greatly elongate, sub-cylindrical, pointed posteriorly; sporonts exceeding 2,000 μ . To the diagnosis of this species as originally given may be added the description of the cysts and sporocysts, which have recently been secured.

Cysts spherical, average diameter 450 μ , the entire surface irregular covered with small elevations and depressions, cyst proper covered with a very thin gelatinous envelope (entirely wanting in some cysts), white when first discharged from the body of the host, but becoming lead gray and finally black as maturation progresses; maturation period for cysts obtained in September, 1913, and kept in water at room temperature, at least ten days; dehiscence simple rupture, with an irregularly spherical central pseudocyst; sporocysts discharged in long chains; each sporocyst subspherical but asymmetrical, one side being distinctly larger and with a greater curvature than the other; when in the chains the sporocysts alternate so that the large side of a sporocyst is always turned away from the large sides of the two adjoining sporocysts; covering of the sporocyst thick, expanded at each end to join with that of the next sporocyst in forming the chains; endosporal mass arranged around a polygonal, hyaline, central spot containing a few granules; sporocysts black or dark brown in color, measuring 7 μ \times 11 μ ; sporozoites differentiating in a few days from the endosporal mass, leaving a central hyaline space with numerous granules.

The writer has taken this gregarine from *Eleodes* sp. and *Asida* sp., collected at Denver, Colorado, also from *Asida opaca* Say and *Eusattus* sp. at Boulder, Colorado.

DACTYLOPHORIDÆ

Epimerite asymmetrical, or asymmetrically placed on the protomerite; cysts dehiscing by simple rupture, usually splitting along the equator, with a pseudocyst; sporocysts cylindrical.

- a. Protomerite represented only by a constricted portion of the body; septum wanting..... *Rhopalonia*
- aa. Protomerite distinct from the deutomerite; septum present.
 - b. Deutomerite not divided by septa.
 - c. Sporocysts cylindrical, usually in chains.
 - d. Sporont short and ovoid; epimerite asymmetrical, consisting of a conical pointed lateral portion and a marginal row of filamentous processes; the conical portion persisting in the sporont stage..... *Echinomera*
 - dd. Sporont elongate; epimerite conical, short and lateral; protomerite broad, upturned on one side, that bearing the epimerite; protomerite with digitiform processes.
 - e. Protomerite bifid on the side away from the epimerite *Pterocephalus*
 - ec. Protomerite not bifid..... *Dactylophorus*
 - cc. Sporocysts more or less ellipsoidal; not in chains.
 - f. Sporocysts not pointed; epimerite short, conical and lateral, borne by a much produced portion of the protomerite..... *Trichorhynchus*
 - ff. Sporocysts pointed..... *Acutispora*
 - bb. Deutomerite divided by one or more granular septa. .. *Metamera*
Rhopalonia Leger, 1893, p. 1285.

Type—*R. geophilii* Leger, 1893, p. 1285-1288; from *Geophilus* sp.—*Chilopoda*.

Echinomera Labbe, 1899, p. 16.

Echinocephalus A. Schneider, 1875, p. 593. Preoccupied.

Type—*E. hispida* (A. Schneider) = *Echinocephalus hispidus* A. Schneider, 1875, p. 593, t. 16, f. 36-40; from *Lithobius forticatus* L.—*Chilopoda*.

Echinomera hispida (A. Schneider). Fig. 60.

Echinocephalus hispidus A. Schneider, 1875, p. 593, t. 16, f. 36-40.

Echinomera hispida. Crawley, 1903a, p. 52; Wyncote, Pennsylvania, Raleigh, North Carolina, and Cambridge, Mass., from *Lithobius forticatus*; Ellis, 1913a, p. 465; Boulder, Colorado, from *Lithobius coloradensis* (Cockerell).

Epimerite asymmetrical, consisting of a pointed conical, lateral portion, and a series of more or less filamentous digitiform processes, the whole be-

ing carried by a short base equalling the protomerite in width; the processes of the epimerite disappearing shortly after the animal frees itself from the intestinal wall of the host, but the conical portion of the epimerite persists in the sporont stage giving an asymmetrical margin to the front of the protomerite; sporont ovoid, length of the protomerite from one-seventh to one-eleventh of the length of the deutomerite; cysts spherical, sporocysts cylindrical; average sporonts $80\mu \times 180\mu$.

Picrocephalus A. Schneider, 1887, p. 67.

Nina Grebnicki, 1873. Preoccupied.

Type—*P. scolopendra* (Kölliker) = *Gregarina scolopendra* Kölliker, 1848; from *Scolopendra* sp.—*Chilopoda*.

Dactylophorus Balbiani, 1889, p. 41.

Dactylophora Leger, 1892, p. 124. Preoccupied.

Type—*D. robustus* (Leger), 1892, p. 124, t. 9; from *Cryptops hortensis* Leach—*Chilopoda*.

Trichorhynchus A. Schneider, 1882, p. 438.

Type—*T. pulcher* A. Schneider, 1882, p. 438; from *Scutigera* sp.—*Chilopoda*.

Trichorhynchus pulcher A. Schneider Fig. 61.

Trichorhynchus pulcher A. Schneider, 1882, p. 438; Crawley, 1903a, p. 52.

Gregarina megacephala Leidy, 1889, p. 11, 1f.; from *Cermatia forceps*.

Epimerite short and conical, borne by a much produced portion of the protomerite; sporont elongate, reaching the length of 800μ ; cysts ovoid; sporocysts cylindrical.

Trichorhynchus lithobii Crawley. Fig. 62.

Trichorhynchus lithobii Crawley, 1903b, p. 637, pl. XXX, f. 18; Raleigh, North Carolina, from *Lithobius* sp.

Since the determination of this gregarine remains quite uncertain until it is more fully described, a portion of Crawley's original diagnosis is copied here to accompany his figure: "An epimerite was not seen. The protomerite was subcordiform, and displayed in front a differentiation the exact nature of which could not be determined. The deutomerite varied considerably in shape, the animal being quite polymorphic.—The largest individual seen was 195 microns long."

Acutispora Crawley, 1903b, p. 632.

Type—*A. macrocephala* Crawley, 1903b, p. 632-633, pl. XXX, f. 1-6; from *Lithobius forcificatus* L.—*Chilopoda*.

Acutispora macrocephala Crawley. Figs. 63-64.

Acutispora macrocephala Crawley, 1903b, p. 632-633, pl. XXX, f. 1-6; Raleigh, North Carolina, from *Lithobius forcificatus*.

Epimerite uncertain; sporont rather elongate, tapering posteriorly, the posterior end of the deutomerite broadly rounded; protomerite constricted near its posterior third, narrower than the deutomerite; width of the pro-

tomterite about one-half of its length, which is a little less than one-third of the total length of the animal; sporocysts ellipsoidal, narrow and pointed, about $4\mu \times 19\mu$; cysts spherical, with a large lateral pseudocyst.

Metamera Duke, 1910, p. 261.

Type—*M. schubergi* Duke, 1910, p. 261-286, pl. 15-16; from *Glossosiphonia complanata* and *Hemiclepsis marginata*—*Hirudinca*.

This genus at present contains but a single species, *M. schubergi* Duke, known from England and Germany. In his description of this species Duke (1910, p. 262), states that it is "identical with a species briefly mentioned by Bolsius in 1895, and the subject of a more detailed but still fragmentary paper in 1896." On the same page Duke calls attention to the fact that Castle (1900), "mentions having observed the gregarine seen by Bolsius in about half the specimens of *Clepsine elongata* which he examined." In this roundabout way there exists a North American record of a gregarine probably referable to the genus *Metamera*. This gregarine, listed as *Gregarina complanata* by Castle (1900, p. 60) from *Glossosiphonia elongata*, is deserving of study when material is obtained.

STENOPHORIDÆ

Dehiscence of cysts by simple rupture; sporocysts ovoid, not in chains; epimerite present only in the intracellular stage; anterior portion of the protomerite with a thin central area in the epicyte so that the protomerite when seen in optical section appears to have a central canal in its anterior end.

Stenophora Labbe, 1899, p. 15.

Stenocephalus A. Schneider, 1875, p. 584. Preoccupied.

Type—*S. juli* (Frantzius) = *Gregarina juli* Frantzius, 1848, p. 191-194; from *Julus* sp.—*Diplopoda*.

Cnemidospora A. Schneider, 1882, p. 446.

The species of this genus are parasites of Diplopods, although two species, *S. erratica* Crawley and *S. gimbeli* Ellis, have been recorded from insects. These two species, as suggested by Crawley (1907) regarding his species *S. erratica*, may be accidental and atypical forms of some of the regular Diplopod-infesting *Stenophoræ*, resulting from the introduction of the sporocysts into the wrong host.

Stenophora robusta Ellis. Fig. 72.

Stenophora robusta Ellis, 1912b, p. 8-11, f.1 a-b; from *Parajulus venustus* Wood and *Orthomorpha gracilis* (Koch), Boulder, Colorado.

Short and ovoid, posterior margin of the deutomerite broadly rounded; protomerite narrower than the deutomerite, subconic, its length about one-eighth of the total length; size under 250μ . The writer has taken this gregarine from specimens of *Orthomorpha* sp., collected at Gold Hill, Colorado, at an altitude of 8400 feet, in November, 1912, by Miss Rosamond Patton.

Stenophora gimbeli Ellis. Fig. 71.

Stenophora gimbeli Ellis, 1913a, p. 464, f. 3-4; Vincennes, Indiana, from *Harpalus pennsylvanicus* Dej.

Short and ovoid, posterior margin of the deutomerite broadly rounded; protomerite almost as wide as deutomerite, hemispherical, wider than long, its length about one-sixth of the total length; average specimens, 500 μ .

Stenophora erratica Crawley. Fig. 69.

Stenophora erratica Crawley, 1907, p. 221, pl. XVIII, f. 5; from *Gryllus abbreviatus*.

Slightly elongate, posterior margin of the deutomerite broadly rounded; protomerite equalling the deutomerite in width, subconical, its length about one-fourth of the total length; reaching the length of 500 μ .

Stenophora julipusilli (Leidy). Fig. 65.

Gregarina julipusilli Leidy, 1853, p. 238, pl. 10, f. 21-22; from *Julus pusillus*.

Stenophora julipusilli, Crawley, 1903b, p. 634, pl. XXX, f. 16-17; from *Julus* sp. and *Parajulus* sp.: Hall, 1907, p. 149; Lincoln, Nebraska.

Somewhat elongate, (young specimens ovoid), posterior margin of the deutomerite rounded; protomerite conical to almost biconic, anterior end rather distinctly pointed; length of the protomerite in adult specimens about one-tenth of the total length.

Stenophora larvata (Leidy). Fig. 70.

Gregarina larvata (Leidy) 1849, p. 232; from *Julus marginatus*.

Gregarina julimarginati Leidy, 1853, p. 237, pl. 10, f. 1-20; from *Julus marginatus*.

Stenophora juli, Crawley, 1903a, p. 51; from *Julus* sp. and *Parajulus* sp.

Elongate, posterior margin of the deutomerite narrowly rounded to almost pointed; protomerite hardly as wide as the widest portion of the deutomerite, hemispherical to subglobose; length of the protomerite about one-twentieth of the total length of adult specimens.

Stenophora spiroboli Crawley. Fig. 66.

Stenophora spiroboli Crawley, 1903a, p. 51-52, pl. 11, f. 22; Raleigh, North Carolina, from *Spirobolus* sp.

Cnemidospora spiroboli Crawley, 1903b, p. 638-639, pl. XXX, f. 7-9.

Elongate, rather pointed posteriorly, protomerite narrower than the deutomerite; length of the protomerite about one-thirty-second of the total length; cysts spherical; sporocysts spindle-shaped, with heavy epispore, size 12.5 μ x 7.5 μ . This species may be a synonym of *S. larvata* (Leidy).

Stenophora cockerellæ Ellis. Fig. 67.

Stenophora cockerellæ Ellis, 1912c, p. 681-685, f. 1-3; Quirigua, Guatemala, from *Parajulus* sp.

Elongate, posterior margin of the deutomerite broadly rounded to almost square; protomerite subglobose with a distinct papilla at its anterior end; width of the protomerite about one half that of the deutomerite, length of the protomerite about one-sixteenth of the total length.

Stenophora elongata Ellis. Fig. 68.

Stenophora elongata Ellis, 1912c, p. 685-686, f. 4; Quirigua, Guatemala, from *Orthomorpha coarctata* (Saussure).

Extremely elongate, posterior margin of the deutomerite rounded; protomerite as wide or slightly wider than the deutomerite, pentagonal in outline, pointed anteriorly; length of the protomerite about one-twenty-fourth of the total length.

DOLIOCYSTIDÆ

Septum wanting, protomerite continuous with the deutomerite; epimerite simple and digitiform; sporocysts oval with an enlargement at anterior ends; habitat, intestine of marine annelids.

Doliocystis Leger, 1893, p. 204-206.

Type—*D. pellucida* (Kölliker) = *Gregarina pellucida* Kölliker, 1848, p. 35, t. 3, f. 31, from *Nereis* sp.—*Polychæta*.

Doliocystis rhynchoboli Crawley.

Doliocystis rhynchoboli Crawley, 1923a, p. 56; *nomen nullum*, Porter, 1897b, p. 8, pl. 3, f. 37; from *Rhynchobolus americanus* Verrill.

Host List

Host	Gregarine
ANNELIDA	
<i>Rhynchobolus americanus</i> Verrill	<i>Doliocystis rhynchoboli</i> Crawley
HIRUDINEA	
<i>Glossiphonia nepheloidea</i> (Graf)	
<i>Glossiphonia elongata</i> Castle...	<i>Metamera</i> sp. ?
DIPLOPODA	
<i>Fontaria</i> sp.	<i>Amphoroides fontariæ</i> Crawley
<i>Julus</i> sp.	<i>Stenophora julipusilli</i> (Leidy)
<i>Julus minutus</i> Brandt	
<i>Julus pusillus</i>	<i>Stenophora julipusilli</i> (Leidy)
<i>Lysiopetalum lacterium</i> (Say)....	<i>Gregarina calverti</i> Crawley
	<i>Stenophora julipusilli</i> (Leidy)
<i>Orthomorpha coarctata</i> (Saussure)	<i>Stenophora elongata</i> Ellis
<i>Orthomorpha gracilis</i> (Knoch) ..	<i>Stenophora robusta</i> Ellis
<i>Orthomorpha</i> sp.	<i>Stenophora robusta</i> Ellis
<i>Parajulus tenustus</i> Wood.....	<i>Stenophora robusta</i> Ellis
<i>Parajulus</i> sp.....	<i>Stenophora cockerellæ</i> Ellis
<i>Parajulus</i> sp.	<i>Stenophora julipusilli</i> (Leidy)
<i>Polydesmus virginianensis</i>	<i>Amphoroides polydesmivirginiensis</i> (Leidy)
<i>Polydesmus</i> sp.....	<i>Amphoroides fontariæ</i> Crawley
<i>Spirobolus marginatus</i> (Say)	
<i>Julus marginatus</i> Say.....	<i>Stenophora larvata</i> (Leidy)
<i>Spirobolus</i> sp.....	<i>Stenophora larvata</i> (Leidy)

CHILOPODA

<i>Lithobius coloradensis</i> (Cockerell)	<i>Echinomera hispida</i> (A. Schneider)
<i>Lithobius forficatus</i> (Linn.)	..... <i>Acutispora macrocephala</i> Crawley
	..... <i>Actinocephalus dujardini</i> A. Schneider
	..... <i>Echinomera hispida</i> (A. Schneider)
<i>Lithobius</i> sp.	..... <i>Trichorhynchus lithobii</i> Crawley
<i>Scolopendra heros</i> Girard	..... <i>Amphorocephalus amphorellus</i> Ellis
<i>Scolopendra woodi</i> Meinert	..... <i>Amphorocephalus actinotus</i> (Leidy)
<i>Scolopocryptops sexspinus</i> (Say)	..... <i>Amphorocephalus actinotus</i> (Leidy)
<i>Scolopocryptops</i> sp.	..... <i>Amphorocephalus actinotus</i> (Leidy)
<i>Scutigera forceps</i> (Rafinesque)	..... <i>Trichorhynchus pulcher</i> A. Schneider
<i>Cermatia forceps</i>	..... <i>Trichorhynchus pulcher</i> A. Schneider

ORTHOPTERA

<i>Blaptica dubia</i> (Serv.)	
<i>Blabera claraziana</i> Saussure	..... <i>Gregarina blaberae</i> Frenzel
<i>Blatta orientalis</i> Linn.	..... <i>Gregarina blattarum</i> Siebold
<i>Periplaneta orientalis</i>	..... <i>Gregarina blattarum</i> Siebold
<i>Blattella germanica</i> (Linn.)	
<i>Ectobia germanica</i>	..... <i>Gregarina blattarum</i> Siebold
<i>Brachystola magna</i> Girard	..... <i>Gregarina rigida</i> (Hall)
<i>Ceuthophilus latens</i> Scudder	..... <i>Gregarina longiducta</i> Ellis
<i>Ceuthophilus maculatus</i> (Harris)	..... <i>Gregarina longiducta</i> Ellis
<i>Ceuthophilus valgus</i> Scudder	..... <i>Gregarina consobrina</i> Ellis
<i>Chortophaga viridifasciata</i> (De Geer)	
<i>Chimarocephalus viridifasciata</i>	..... <i>Actinocephalus pachydermus</i> (Crawl.)
<i>Dissosteira carolina</i> (Linn.)	..... <i>Actinocephalus pachydermus</i> (Crawl.)
<i>Locusta carolina</i> Linn.	..... <i>Gregarina locustæcarolinæ</i> Leidy
<i>Gryllus abbreviatus</i> Serv.	..... <i>Stenophora erratica</i> Crawley
<i>Acheta abbreviata</i>	..... <i>Gregarina acheta-abbreviata</i> Leidy
	..... <i>Gigaductus kingi</i> (Crawley)
<i>Gryllus americanus</i> Blatchley	..... <i>Gregarina acheta-abbreviata</i> Leidy
<i>Ischnoptera pennsylvanica</i> (De Geer)	..... <i>Gregarina blattarum</i> Siebold
<i>Melanoplus angustipennis</i> (Dodge)	..... <i>Gregarina rigida</i> (Hall)
<i>Melanoplus atlantis</i> (Riley)	..... <i>Gregarina rigida</i> (Hall)
<i>Melanoplus bivittatus</i> (Say)	..... <i>Gregarina rigida</i> (Hall)
<i>Melanoplus coloradus</i> Caudell	
<i>Melanoplus coloradensis</i>	..... <i>Gregarina rigida</i> (Hall)
<i>Melanoplus differentialis</i> (Uhler)	..... <i>Gregarina rigida</i> (Hall)
<i>Melanoplus femoratus</i> (Burmeis- ter)	..... <i>Gregarina rigida</i> (Hall)
<i>Melanoplus femur-rubrum</i> (De- Geer)	..... <i>Gregarina rigida</i> (Hall)

- Melanoplus luridus* (Dodge) *Gregarina rigida* (Hall)
Panchlora exoleta Burmeister *Gregarina panchloræ* Frenzel
Periplaneta americana (Linn.) *Gregarina blattarum* Siebold
Gregarina serpentula Magalhães

ISOPTERA

- Termes flavipes* Kollar *Gregarina termitis* Leidy
Termes lucifugus Rossi *Gregarina termitis* Leidy

ODONATA

- Aeshna constricta* Say, nymph *Geniorhynchus æshnæ* Crawley
Aeshna sp., nymph *Actinocephalus brachydactylus* Ellis

COLEOPTERA

- Acilius* sp.
Acilius sulcatus (European) *Bothriopsis histrio* A. Schneider
Alobates pennsylvanicus (DeGeer) *Actinocephalus zophus* (Ellis)
Nyctobates pennsylvanicus *Anthorhynchus philicus* (Leidy)
Nyctobates pennsylvanicus barbata (Knoch) *Actinocephalus zophus* (Ellis)
Asida opaca Say *Stylocephalus giganteus* Ellis
Boletophagus sp.
Boletophagus cornutus *Anthorhynchus boletophagi* (Crawl.)
Colymbetes sp.
Colymbetes fuscus Linn. (European) *Bothriopsis histrio* A. Schneider
Cratoparis lunatus (Fab.) *Anthorhynchus cratoparis* (Crawl.)
Cucujid larvæ *Gregarina elateræ* Crawley
Dermestes peruvianus Castelnau . . *Pyxinia crystalligera* Frenzel
Dermestes vulpinus Fab. *Pyxinia crystalligera* Frenzel
Dicælus ovalis LeConte *Actinocephalus discæli* (Crawl.)
Elater sp., larvæ *Gregarina elateræ* Crawley
Eleodes hispilabris (Say) *Stylocephalus giganteus* Ellis
Eleodes sp. *Stylocephalus giganteus* Ellis
Eusattus sp. *Stylocephalus giganteus* Ellis
Galerita bicolor Drury *Actinocephalus americanus* Crawl.
Harpalus caliginosus Fab. *Gigaductus parvus* Crawley
Actinocephalus harpali (Crawl.)
Harpalus pennsylvanicus DeGeer . . *Gigaductus parvus* Crawley
Stenophora gimbeli Ellis
Holocephala bicornis Olivier *Gregarina microcephala* Leidy
Hydaticus sp.
Hydaticus cinereus, larvæ (European) *Bothriopsis histrio* A. Schneider
Hydrophilus sp. *Legeria terpsichorella* Ellis
Leptochirus edax Sharp *Actinocephalus crassus* (Ellis)
Stylocystis ensiferus (Ellis)

- Ligyru8 relictus* (Say)
Scarabeus relictus, larvæ.....*Gregarina scarabeirelecti* Leidy
Lucanus dama Thunb.....*Euspora lucani* Crawley
Necrobia ruficollis Fab.
Corynetes ruficollis*Gregarina bergi* Frenzel
Neleus interstitialis Esch.....*Gregarina guatemalensis* Ellis
Passalus cornutus Fab.....*Gregarina passalicornuti* Leidy
Serica brunnea Linn.
Melalontha brunnea*Gregarina melalonthæ-brunneæ* (Leidy)
Statira unicolor Blanchard.....*Gregarina statiræ* Frenzel
Tenebrio castaneus Knoch.....*Gregarina grisea* Ellis
Xylopinus saperdioides (Olivier).*Gregarina xylopinii* Crawley
Actinocephalus zophus (Ellis)

TUNICATA

- Perophora annectens* Ritter.....*Gregarina* sp.

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EXPLANATION OF FIGURES

PLATE XVII

FIGURE

1. *Euspora lucani* Crawley. Association. (After Crawley, 1903a, pl. III, f. 38).
2. *Gregarina blaberæ* Frenzel. Sporont. (After Frenzel, 1892, f. 22).
3. *Gregarina serpentula* Magalhães. Association. (After Magalhães, 1900, f. 4).
4. *Gregarina calverti* Crawley. Sporont. (After Crawley, 1903a, pl. II, f. 19).
5. *Gregarina acheta-abbreviata* Leidy. Association. Douglas Lake, Michigan.
6. *Gregarina termitis* Leidy. Sporont. Boulder, Colorado.
7. *Gigaductus kingi* (Crawley). Association. (After Crawley, 1907, f. 10).
8. *Gigaductus parvus* Crawley. Association. Vincennes, Indiana.
9. *Gregarina panchloræ* Frenzel. Anterior portion of satellite. (After Frenzel, 1892, f. 20).
10. *Gregarina clateræ* Crawley. Cephalont. (After Crawley, 1903a, pl. I, f. 11).
11. *Gregarina elateræ* Crawley. Sporont. (After Crawley, 1903a, pl. I, f. 5).
12. *Gregarina passalicornuti* Leidy. Association. (After Leidy, 1853, pl. II, f. 30).
13. *Gregarina rigida* (Hall). Sporont. Boulder, Colorado.
14. *Gregarina statiræ* Frenzel. Association. (After Frenzel, 1892, f. 1).
15. *Gregarina guatemalensis* Ellis. Association. Quirigua, Guatemala.
16. *Gregarina passalicornuti* Leidy. Sporont. New Orleans, Louisiana.
17. *Gregarina xylophini* Crawley. Association. (After Crawley, 1903a, pl. III, f. 30).
18. *Gregarina grisea* Ellis. Association. New Orleans, Louisiana.
19. *Gregarina locustecarolinæ* Leidy. Cephalont. (After Crawley, 1907, f. 13).

PLATE XVIII

20. *Gregarina blattarum* Siebold. Association. Douglas Lake, Michigan.
21. *Gregarina blattarum* Siebold. Sporocyst. Douglas Lake, Michigan.
22. *Gregarina blattarum* Siebold. Cyst with developing sporoduct-buds. Michigan.
23. *Gregarina consobrina* Ellis. Cephalont. Boulder, Colorado.
24. *Gregarina consobrina* Ellis. Association. Boulder, Colorado.
25. *Gregarina consobrina* Ellis. Dehiscing cyst. Boulder, Colorado.

26. *Gregarina longiducta* Ellis. Dehiscing cyst. Douglas Lake, Michigan.
27. *Gregarina longiducta* Ellis. Cephalont. Douglas Lake, Michigan.
28. *Gregarina longiducta* Ellis. Sporocyst. Douglas Lake, Michigan.
29. *Gregarina longiducta* Ellis. Association. Douglas Lake, Michigan.
30. *Legeria terpsichorella* Ellis. Sporont. Douglas Lake, Michigan.
31. *Actinocephalus brachydactylus* Ellis. Anterior portion of cephalont. Michigan.
32. *Actinocephalus brachydactylus* Ellis. Cephalont. Douglas Lake, Michigan.
33. *Actinocephalus brachydactylus* Ellis. Sporont. Douglas Lake, Michigan.

PLATE XIX

34. *Stylocystis ensiferus* (Ellis). Cephalont. Quirigua, Guatemala.
35. *Stylocystis ensiferus* (Ellis). Sporont. Quirigua, Guatemala.
36. *Amphorooides polydesmirvirginiensis* (Leidy). Sporont. (After Crawley, 1903a, f. 25).
37. *Amphorooides fontariae* Crawley. Sporont. East Falls Church, Virginia.
38. *Gregarina bergi* Frenzel. Cephalont. (After Frenzel, 1892, f. 16).
39. *Gregarina bergi* Frenzel. Sporont. (After Frenzel, 1892, f. 17).
40. *Actinocephalus crassus* (Ellis). Sporont. Quirigua, Guatemala.
41. *Geniorhynchus æshnæ* Crawley. Cephalont. (After Crawley, 1907, f. 4).
42. *Bothriopsis histrio* A. Schneider. Cephalont. (After Leger, 1892, pl. XIII, f. 1).
43. *Pyxinia crystalligera* Frenzel. Cephalont. (After Frenzel, 1892, f. 35).
44. *Pyxinia crystalligera* Frenzel. Sporont. (After Frenzel, 1892, f. 39).
45. *Actinocephalus dujardini* A. Schneider. Cephalont. (After Schneider, 1875, pl. XVI, f. 9.)
46. *Actinocephalus harpali* (Crawley). Sporont. (After Crawley, 1903a, pl. I, f. 1).
47. *Authorhynchus cratoparis* (Crawley). Cephalont. (After Crawley, 1903a, pl. II, f. 23).
48. *Authorhynchus philicus* (Leidy). Cephalont. (After Crawley, 1903a, pl. III, f. 31).
49. *Actinocephalus zophus* (Ellis). Cephalont. New Orleans, Louisiana.
50. *Actinocephalus discæli* (Crawley). Sporont. (After Crawley, 1903a, pl. I, f. 7).
51. *Amphorocephalus amphorellus* Ellis. Sporont. Boulder, Colorado.
52. *Amphorocephalus amphorellus* Ellis. Cephalont. Boulder, Colorado.
53. *Amphorocephalus actinotus* (Leidy). Cephalont. (After Crawley, 1903a, pl. III, f. 37).
54. *Actinocephalus pachydermus* (Crawley). Sporont. (After Crawley, 1907, f. 3).

55. *Actinocephalus pachydermus* (Crawley). Cephalont. (After Leidy, 1853, pl. 11, f. 37).
56. *Actinocephalus americanus* Crawley. Sporont. (After Crawley, 1903b, f. 22).
57. *Anthorhynchus boletophagi* (Crawley). Sporont. (After Crawley, 1903a, pl. II, f. 26).

PLATE XX

58. *Stylocephalus giganteus* Ellis. Anterior portion of a cephalont. Boulder, Colo.
59. *Stylocephalus giganteus* Ellis. Sporont. Boulder, Colorado.
- 59s. *Stylocephalus giganteus* Ellis. Sporocysts. Boulder, Colorado.
60. *Echinomera hispida* (A. Schneider). Cephalont. Boulder, Colorado.
61. *Trichorhynchus pulcher* A. Schneider. Anterior portion of a cephalont. (After Schneider, 1882, f. 4).
62. *Trichorhynchus lithobii* Crawley. Sporont. (After Crawley, 1903b, f. 18).
63. *Acutispora macrocephala* Crawley. Sporont. (After Crawley, 1903b, f. 1).
64. *Acutispora macrocephala* Crawley. Sporocyst. (After Crawley, 1903b, f. 3).
65. *Stenophora julipusilli* (Leidy). Young sporont. After Leidy, 1853, pl. 10, f. 21).
66. *Stenophora spiroboli* Crawley. Sporont. (After Crawley, 1903a, pl. II, f. 22).
67. *Stenophora cockerellæ* Ellis. Sporont. Quirigua, Guatemala.
68. *Stenophora elongata* Ellis. Sporont. Quirigua, Guatemala.
69. *Stenophora erratica* Crawley. Sporont. After Crawley, 1907, f. 5).
70. *Stenophora larvata* (Leidy). Sporont. (After Leidy, 1853, pl. 10, f. 1).
71. *Stenophora gimbeli* Ellis. Sporont. Vincennes, Indiana.
72. *Stenophora robusta* Ellis. Sporont. Boulder, Colorado.